THE DISCONTINUITIES OF EVOLUTION[1]

BY

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I

This lectureship, since it is a gift to the University itself, is not, of course, intended as an endowment for the promotion of a particular philosophic doctrine, not even that of the venerated teacher whose memory it is meant to perpetuate as long as the University endures, and whose deepest conviction, that "the life that is without examination is not worthy to be lived by man," it will always express. Nevertheless, it is natural that an old pupil of Professor Howison's, when honored with the privilege of lecturing upon this foundation, should choose a theme having some close relation to the philosophical questions which to him seemed especially significant, and with which his own reflection was chiefly engrossed. One such question, clearly, was that concerning the extent and limits of the pertinency of the notion of evolution in philosophy, and the possibility of 'accounting for' man and his consciousness, his reason, and his conscience, by means of that notion. Professor Howison's primary contention upon this matter was (it need hardly be said here) that each individual mind in its essential being belongs to an eternal or noumenal order, outside of time altogether and therefore not subject to becoming, and that it is only in his 'empirical' existence that man is part of the phenomenal world and entangled in the temporal processes which go on therein. With that contention this lecture will not be concerned; but I should depart from the candor practised and demanded by Mr. Howison—who was wholly averse to glossing over real philosophical differences—if I did not say, in passing, that I do not find this part of his philosophy persuasive. It was here, it seems to me, under the influence—as was most American and English philosophy in the last quarter of the nineteenth century—of an unfortunate element in the Kantian tradition. The philosophers who inherited that tradition have been interested chiefly in supratemporal realities. They have been concerned to show that time is not 'ultimately' (whatever that may mean) real, and that the time-experience itself presupposes a time-transcending and synthetizing unity; so that the whole temporal world—or the whole of it except that aspect which consists in moral striving, for which the neo-Kantian idealist has always exhibited an admirable but, as it has seemed to me, an inconsistent respect—has thus been to many idealistic metaphysicians a thing to be treated a little superciliously; their speculations have moved mainly in another realm. For myself, I must confess that I have never been able to conceive how a timeless ego, with its unalterable nature, could be significantly related to or determinative of any particular temporal event whatever—least of all how such a being could be expressed in, or import freedom into, man's moral experience, which consists wholly of temporal events. All that was deepest, most personal and original in Professor Howison's thought would, I believe, have found more appropriate and adequate expression if it had been unencumbered by this legacy of Kantian eternalism. This feeling may, possibly enough, be due only to some congenital blind-spot or invincible ignorance on my part; yet whatever be its cause, it compels me to limit my own philosophic attention to the temporal world—where philosophers will not, I think, find any scarcity of problems to occupy them.

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[1] Second Annual Howison Lecture, delivered at the University of California, March 25, 1924.

To that world Professor Howison did not, of course, deny the applicability of the conception of evolution; on the contrary, he insisted upon it. "In this world of sense, this essentially incomplete and tentative world of experience, evolution must reign continually.''[2] Yet even here he was wont to urge a serious difficulty. ''Can evolution,'' he asked, ''be made validly continuous throughout the world of *phenomena?* . . . . . What is the continuous thread by which a unity of development is to hold not only among living beings, but also among those without life, since it cannot any longer be physiological descent? How is the chasm that now comes into view between the organic and the inorganic to be bridged?'' His own resort to what seems to me the desperate expedient of withdrawing the true being of man from the world of change altogether was plainly due in part to the fact that the then dominant evolutionistic philosophies seemed to imply a sort of continuity which he found to be inadmissible. They either asserted or suggested that the later and higher stages of evolution are somehow implicit in the prior and lower stages; that an intelligible and necessary causal nexus runs through the whole process; that the way truly and adequately to understand intelligence or consciousness or life is to apply to them the categories and principles of the supposedly more 'fundamental' sciences which deal with objects apparently destitute of intelligence or consciousness or life; and that there is thus no real 'chasm' between the inorganic and the organic or between man and other creatures.

During the thirty years since Professor Howison was urging, here in California, the question I have quoted, there has been an increasing number of other philosophers who have turned their reflection upon it; and, what is more surprising, there has been evident among them a great and growing tendency to agreement in the answer they give to it. Unanimity is not, perhaps, the attribute most distinctive of philosophers as a body; and in recent decades the general philosophical situation has seemed in most respects exceptionally confused, a restless welter of conflicting tendencies. Yet on one issue, at least, there has been, not, assuredly, a universal, yet a very extensive and striking, convergence of opinion. Thinkers of many and opposing schools have concurred in declaring—with whatever differences of terminology—that the evolutional process, the sequence of temporal changes constituting, for example, the total history of our solar system from nebula to man, is not, properly speaking, continuous, that it does indeed, in certain respects, show breaks or 'chasms,' that it exhibits the 'emergence' from time to time of absolute novelties, discontinuous variations in no way deducible from, or explicable by, any characters of the prior members of the series. Among recent or living philosophers who apparently agree in accepting in some form, and in most diverse metaphysical and epistemological settings, the theory of 'creative' or 'emergent evolution,' may be mentioned Boutroux, Bergson, S. Alexander, Whitehead, Kemp Smith, Hobhouse, Laird, Baldwin, Sellars. The list might easily be extended. Within the past year the dean of British scientific psychologists, Lloyd Morgan, has devoted a volume primarily to the exposition and defense of a theory of this type. His thesis may be summarized in his own words:

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[2] *The Limits of Evolution* (1901), xvi; cf. also xxiv.

> The orderly sequence of natural events, historically viewed, appears to present, from time to time, something genuinely new. Under what I call emergent evolution stress is laid on this incoming of the new. Salient examples are afforded in the advent of life, in the advent of mind, and in the advent of reflective thought. . . . . But if nothing new emerge—if there be only regrouping of pre-existing elements and nothing more—then there is no emergent evolution.[3]

This tendency, it is manifest, is in part inspired by the same motives as the idealistic reaction which took place, especially in Great Britain and America, in the second half of the nineteenth century against the then most conspicuous and most influential attempt to elaborate an evolutionistic philosophy. The system which, above all others in the last century, professed to deal with the universe *sub specie generationis*—that of Spencer—presented itself in the guise of a sequence of deductions from mechanical principles. The establishment of the law of the conservation of energy and of the doctrine of the transformation of species had given new life to an ambitious project long before outlined by

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[3] *Emergent Evolution* (1923), pp. 1–2. I have slightly abridged the citation.

Descartes: the project of inferring from a few laws of motion—laws, that is, of the mere rearrangement of a quantitatively invariable physical system—the necessity for the gradual passage of that system through a series of phases identical (where comparison was possible) with those depicted by the historical portions of physical science, until the world assumes the character that science now finds it possessing. The second part of Spencer's *First Principles* and the volumes which followed it, at least in the early editions, were supposed at once to exhibit a complete unification of knowledge and to reconstruct—in great part a priori—the history of the ever-increasing complication of the cosmos.[4] One of the objections of many neo-Kantian idealists to this—and, as I have intimated, one of the objections of Professor Howison—related to the mechanistic character of this sort of evolutionism, and especially to its ostensible attempt to reduce all the functions even of human life itself to special cases of the same fundamental mechanical phenomena exemplified everywhere else in nature. The doctrine of emergent evolution is a revolt of temporalistic, and usually realistic, philosophers against the same features of the older evolutionism. The union of the conception of evolution with the conception of reality as a complex of which all the parts are theoretically deducible from a very small number of relatively simple laws of the redistribution of a quantitatively invariable sum of matter and of energy—this union the 'emergent evolutionist,' if I may so call him for short, now declares to be a *mésalliance,* of which the progeny are hybrid monsters incapable of survival.

Agreement among a large number of philosophers, though a pleasant and not too common spectacle, does not, of course, prove anything. Large numbers of philosophers have been agreed before upon conclusions which most are now agreed in rejecting—being in this, after all, not very different from other men, not even from mathematicians. But the doctrine of emergent evolution is manifestly important if true; and there are, I think, good reasons for believing it true. I should like, therefore, to attempt, first, to do a little to make more definite its meaning and to indicate some of its relations to other philosophical issues; and second, to present some considerations favorable to the theory, or rather to a particular phase of it. For the doctrine seems to me to have been left hitherto in an unduly general and nebulous condition.

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[4] It has been pointed out by Lloyd Morgan in his Oxford lecture on *Herbert Spencer's Philosophy of Science* that Spencer himself in the end abandoned his earlier position, at least with respect to the continuity between inorganic and organic phenomena; e.g., in the last (1898) edition of the *Principles of Biology:* "The processes that go on in living things are incomprehensible as the results of any physical actions known to us . . . . . In brief, we are obliged to confess that life in its essence cannot be conceived in physico-chemical terms."

The question as propounded by Lloyd Morgan is that of the emergence of the 'new.' But what is meant by 'new'? The word is manifestly equivocal, and there are senses of it in which the constant appearance of 'new' things is patent and undisputable. If the adjective 'new' is used without specification of some limited sense, the theory of emergent evolution becomes pure banality; it asserts what nobody denies. Obviously any change implies novelty in some sense. While the concept of 'novelty,' as pertinent to this matter, needs to have more careful distinctions applied to it than it has yet received, I shall not here attempt such an analysis of its discriminable meanings. I merely enumerate the sorts of novelty the occurrence of which (if established) would seem to me to justify a theory of emergent evolution. They would consist in the appearance at certain points in the history of some system of (*a*) *qualities* not previously found anywhere in that system; or (*b*) *types of objects or events* not previously existent therein, not mere combinations of anything previously existent, and characterized by new qualities; or (*c*) *laws*, i.e., modes of uniform action, not previously exemplified by any entities in the system. In the last case we should distinguish between the possible emergence of new laws in conjunction with the appearance of new qualities or entities, and the emergence of new laws of action of entities otherwise unchanged. I will add that if there are philosophers present who would maintain that there is no ultimate distinction between the first and second of the modes of novelty mentioned I shall not here dispute the point, since it is not of importance for my present argument. It should, of course, be understood, that these three conceivable classes of 'emergents' do not necessarily imply one another; and that some philosophers may assert emergent evolution in one of these respects and not in the others. For example, it might be held—and is, I think, by certain contemporaries held—that entities of a new kind, namely, conscious processes or states, have emerged somewhere in the course of evolution, but that the appearance of these—though they have, of course, their own laws—has not been accompanied by the emergence of any new laws of the action of any of the assumed previously existent type of entities, viz., of material particles or units of energy. On the other hand, it might without obvious inconsistency be asserted, and is asserted by some contemporary philosophers, that new laws have 'emerged' without the emergence of any new entities (other than spatial regroupings of old ones). In none of these cases, again, need the assertion of an 'emergence' mean that the 'new kind' of fact is absolutely without precedent. 'Emergence,' as the definition already given implies, can be profitably discussed only with reference to the processes going on in some determinate, limited, and relatively isolated system. If, for example, there prove to be something irreducibly different in the qualities or the modes of action exhibited respectively by non-living and living beings, then the first appearance of life in the history of our solar system—unless it came about, as has been argued by H. E. Richter, Kelvin, Helmholtz, and Arrhenius, by immigration from without—would not be the less a case of emergence merely because in other solar systems living beings may have earlier made their appearance.

It is evident that the three general questions into which the issue seems to resolve itself involve, in diverse and complicated ways, other, and sometimes very ancient, problems of philosophy. For example, the first—the question of the emergence of qualities—in so far as it relates to the sensible qualities of objects, is entangled with the discussion whether the so-called secondary qualities of perceived things—color, sound, taste, smell, etc.—are objective or subjective. A philosophic realist who holds, as we were all, I suppose, taught in our school-days, that the color red—not the undulation, but the actual quality as we sensibly experience it—exists only when a sentient organism having a certain psycho-physiological constitution exists to perceive it, will almost certainly conclude that an interesting sort of emergent evolution has taken place. He will, that is, believe that—in our solar system, at any rate—there was once no such fact as the peculiar quale of sensible red; and that at a certain point in its history that system received an extraordinary enrichment, consisting in the addition of redness (at least as a fact in the experience of organisms). The only alternative (given his premises) to this conclusion, would imply that from the earliest phase of the history of the system sentient organisms existed having precisely the organs and sensibilities necessary for color-vision—a view which is obviously inconsistent with all that we are supposed to know about stellar evolution. On the other hand, one who holds—as a number of American and British realists now do—that there is no 'bifurcation' of nature, that all sensible qualities alike are independent elements of a real physical world, would not be so obviously compelled to regard the secondary qualities as evidences of emergent evolution. Whether he would be under any necessity of doing so at all is an interesting question, into which I must not here enter. Doubtless he *may,* at any rate, without manifest inconsistency, unite both views; the doctrine of Samuel Alexander exemplifies such a union. In his opinion "the sense quality owes nothing to the mind itself (nor for that matter to the physiological organ), which is but the means or instrument whereby an external sense-quality belonging to the thing itself is revealed."[5] (What and where, stated in terms of present theories of the constitution of matter, the colored "thing-itself" is or, indeed, can be, I find it a little difficult to understand; but I must again avoid a side issue which tempts to controversy.) And yet, as Alexander conceives, the secondary qualities did not always exist in our world; they supervened upon the primary, as the primary had earlier supervened upon a merely qualityless world of space-time. One consequence of such a union of emergent evolutionism with the doctrine of the objectivity of the secondary qualities is immediately apparent. One of the commonest arguments in favor of the latter doctrine is a realistic adaptation of one of Bishop Berkeley's. You can't, said Berkeley, separate the secondary qualities in thought from the primary; and, as the secondary are admittedly subjective, the primary must be so too. Neo-realists sometimes still reason from the same major premise, though to the opposite conclusion; the primary qualities, they argue, being inconceivable apart from the secondary, and the primary being indubitably objective characters of independent realities, the secondary may be so too. But a neo-realist who is also a believer in the emergent evolution of qualities is manifestly debarred from reasoning thus. Believing that primary qualities were present in nature *before* the secondary, he is obliged to affirm that we can conceive of the one as existing without the other.[6] His belief in 'emergence,' in other words, though it may be reconcilable with his conviction of the objectivity of secondary qualities, certainly weakens the case for the latter view.

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[5] *Space, Time and Deity,* II, p. 58.

It is not, however, with the problems concerning the evolution of qualities that this lecture is chiefly concerned. I have touched upon these problems in passing only by way of illustrating the interrelation of the question of emergent evolution with other mooted issues which might at first sight appear quite distinct from it. Nor shall I deal, except indirectly, with the second of the questions mentioned, which has to do with the hypothesis of the emergence of psychical entities as pure discontinuous additions to an already existent physical world. It is of the third question—that concerning the evolution of natural laws—that I wish to speak in the time that remains. We are to consider the hypothesis that laws of nature have themselves been evolved in the course of time, that they too, or some of them, are 'emergents.' And to narrow the issue still further, we shall eliminate problems of purely qualitative change, and consider only laws relating to the movements of material things, including animal and human bodies. I choose this phase of the subject partly because it brings the question of emergent evolution into connection with two familiar philosophical issues—the issue concerning vitalism and that concerning the 'efficacy of consciousness'—which have usually been discussed without regard to it; but chiefly because it raises a peculiarly momentous and critical problem for any realistic philosophy. Is there any real emergence of novelty, any creative evolution, in the dynamic or executive part of nature, in the modes of behavior of those entities which physical science regards as having been longest upon the cosmic scene and of which our own bodies consist? Has there or has there not come about an increasing enrichment of that répertoire of dances which atoms perform upon the stage of space and time? If new qualities or qualitatively new processes—such as feeling, perception, thought—have come into being, has their emergence had any effect upon the action of the entities that were there before; or must we say that all that has emerged amounts, at most, to a transitory surface-iridescence upon an underlying and abiding world which, through all the cycles of cosmical history, has acquired no new accomplishments of its own and has remained wholly unaffected by the shimmer of color and sound and sentiency and rational thought which has somehow supervened upon it? It may be that no answer to this question is possible; but it is clearly a question which philosophy is bound to ask and, with the indispensable aid of natural science, to explore, so far as our powers and our present knowledge permit.

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[6] This consequence, it should be said, is clearly recognized by Alexander himself; *op. cit.*, II, p. 61.

II

The question, however, requires much further clarification before it can be satisfactorily discussed. It is, perhaps, in the first place, needful though obvious to remark that 'laws,' as such, i.e., generalizations about the correlations of qualities or events, do not emerge at all until human beings formulate them. A law of nature—it need scarcely be said—is not itself a natural event or a cause of natural events, though it may perhaps be a part of that timeless world of Platonic ideas which has come into fashion again in contemporary philosophy. When I speak, then, of a conceivable form of emergent evolution which might consist in the emergence of novel laws, I am using this expression only for the sake of brevity. I mean the appearance of some correlation of events or method of action which cannot be correctly described by the generalizations that would have correctly described all the correlations of previous events or methods of action.

It may be well, in the second place, to point out that the hypothesis of an emergence in time of new laws in the physical world is not to be identified with a theory put forward by C. S. Peirce a number of years ago, and recently republished in a collected edition of his principal papers. According to this theory, to which Peirce gave the name of tychism, there was—or ought to have been—a phase in cosmic history at which phenomena conformed to no laws at all, i.e., exhibited no uniformities in their behavior. It may seem, but really is not, odd that this hypothesis was partly motivated by a desire to conceive of the world as rational and intelligible. For the essence of every empirical law, that is, of every specific natural uniformity, is a kind of arbitrariness. To assert such a law is to say that, whereas a given type of repeated event, such as the motion of a given particle, conceivably *might* happen in many different ways in its successive occurrences, it in fact happens in one unvarying way, all the other abstract logical possibilities being forever arbitrarily excluded.

But a world of chance would be a world, the only kind of world, which, among the logical possibilities, had no favorites. For the rule of arithmetical probability, applied with complete generality, is the rule of equal opportunity for every conceivable, i.e., not self-contradictory, kind of thing and combination of things. Where there is favoritism—when, for example, in a series of throws of a die one theoretical possibility turns up empirically much more often than any other—you have, with respect to that series of events, not chance, but a law, i.e., a formulable uniformity, which can usually be carried back to other and more fundamental laws—probably, in the case of the die, to a law relating in part to certain tendencies of human nature. But when, in such a process of so-called explanation, the supposed ultimate laws were reached, you would then simply have before you blankly inexplicable, persistent preferences of nature for doing things in certain ways, when, so far as pure reason is concerned, other ways were equally open to her. Thus there is a sense in which it may be said that the only thorough rationalization of the world would consist in showing it to be ultimately or originally *not* a world of law but a world of chance; and that what we call explaining a particular fact by referring it to *any* law of uniformity, however comprehensive, must leave the basis of your 'explanation' itself unexplained.

Now Charles Peirce seems to have felt a craving, natural to a logician, to believe in the logicality of the universe, and to carry through his explanations to the limit; and it was partly for this reason (though partly for quite a different one) that he thought it needful to put chance before law in the order of things. The fault of most theories of cosmic evolution, it seemed to him, was that they left the *laws* of evolution unaccounted for. "Law is *par excellence* the thing that wants a reason. . . . To suppose universal laws of nature capable of being apprehended by the mind and yet having no reason for their special forms, but standing inexplicable and irrational, is hardly a justifiable position." But "the only possible way of accounting for the laws of nature and for uniformity in general, is to suppose them results of evolution.''[7] ''Philosophy requires a thorough-going evolution or none.'' Nature's conformity to law, in short, must be an acquired character. The infant universe, as Peirce conceived it, must have been like the legendary freshman who came to college with a recommendation from his pastor testifiying that he ''had no habits of any kind.'' When nature herself was thus in a state of nature, the primeval entities ''sported here and there in pure arbitrariness''; the game was played under different rules every day—except, of course, that there were no days. Yet, somehow, the world did not continue in this kittenish humor. One of its random variations was, it seems, a tendency *not* to vary; and this tendency, oddly enough, proved less ''evanescent'' than the others. Emerging thus from its *jeunesse orageuse,* the universe became more and more a creature of routine; and so ''all its regularities'' were ''evolved.'' Yet even now, Peirce contended, there is a large margin of pure freedom and spontaneity in reality; ''the precise and universal conformity of facts to law'' is not ''clearly proved, or even rendered particularly probable, by any observations hitherto made.''[8]

A critical consideration of Peirce's tychism does not fall within the purpose of this lecture. I wish only to make clear the distinction between such a view and the conception with which we are here concerned. The doctrine of the emergent evolution of laws of motion of the units of matter, or of differing aggregates of it, does not imply that there were once no laws of motion. It assumes that all motions occur in accordance with some sort of ascertainable laws; but holds that when bodies or particles moving uniformly in a given manner reach certain novel 'junctures'—as I shall call them—they thereupon begin to move in accordance with new laws that are logically discontinuous with those which their motions previously exemplified. A law in general is, of course, a statement that a defined type of variable event is a function of, i.e., occurs in a fixed correlation with or ratio to, certain other variables. Thus, when such a law is known and the values of the latter variables have been empirically determined in a given case, the mode of occurrence of the event in the same case can be deduced. Two (or more) laws are said to be discontinuous *inter se* when neither can be deduced either from the other or from any more general law from which the other can also be deduced—even though the values of the pertinent variables are empirically known and the computation necessary is within the power of our minds.[9] For if the one law could be deduced from the other, this would mean that, in spite of the seeming diversity of the two instances of the event, nature was in both instances simply performing the same trick; each of the units of matter or energy, for example, would be behaving, with respect to any given character of the other units, in exactly the same manner, though, since the number and grouping of the units would differ, the gross sensible appearances of the two events might be exceedingly dissimilar. Thus—assuming, for the sake of illustration, the literal correctness of the Newtonian law of gravitation—the motion of the planets in their elliptical orbits, the movements of comets upon variously curved orbits, the apparently rectilinear motion of falling bodies upon the earth, were all shown by Newton to be no evidences of versatility on the part of nature, but to be merely special and deducible cases of a single mode, or at any rate not more than two modes, of action of matter, stated in terms of acceleration, mass, distance, and relative direction in a single space.

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[7] *Chance, Love and Logic* (1923), pp. 175 ff.; cf. Morris Cohen's apparently sympathetic comment on this hypothesis, *ibid.*, pp. xii–xiii.

[8] *Ibid.*, p. 191.

Of discontinuities between laws, as here defined, four conceivable sorts may be distinguished. (1) The instances of a given type of event—e.g., of motion, with respect to direction or velocity or both—might all conform to laws expressible in terms of the same variables, but the *same* law might not hold good for all values of those variables; i.e., one class of instances might be one function of those variables, another class another function of them. This would be illustrated—to take, for the present, an imaginary case—if Newton's law of gravitation were found by astronomers to conform precisely to the observable facts concerning the accelerations of bodies within a certain distance, but beyond that distance to be replaced by a law of inverse cubes. (2) Another type of discontinuity would be that in which different instances of the same generic type of event required for the correct formulation of the laws of their occurrence the introduction of different variables. (3) A third, though kindred, type is exemplified whenever science finds itself obliged to invoke different 'forces'—in the traditional language of physics—in order to bring under the notion of law even a single event. Newton, for example, as everyone knows, supposed bodies to be acted upon simultaneously by two forces, inertial and gravitational. The action of each of these could be formulated as a law; but, as it at that time appeared, these laws, though jointly operative, were undeducible from one another or from any common law. They imputed to matter a somewhat Hamlet-like character—a disposition (in certain situations) to do two irreconcilable things at once, and a consequent necessity of compromising between these conflicting propensities. (4) Finally, the laws of two classes of events may be said to be discontinuous if the events are so different in nature that they cannot be described in the same generic terms. Here it should be noted that the laws of such events may be discontinuous, in the sense defined, even though one of the events be actually a function of the other. For example, if it be assumed—what should be obvious, but apparently is not so to some minds—that a color-quality as experienced is not an undulatory motion, and that an undulatory motion is not itself a color-quality—it follows that not even the most complete knowledge of the laws of undulation of the ether (or whatever it is that undulates) could enable anyone to deduce either that there must occur any such event as a color-sensation or that, if it does occur, an undulation of a particular wave-length impinging on a retina will give rise to the particular color-sensation blue. Nor could the most complete knowledge of color-sensations, purely as experienced qualities, enable anyone to deduce that they arise upon the occasion of certain undulatory motions outside the body. Nevertheless, the physicist tells us that these two classes of events are in fact correlated. This means simply that the impact of an undulation upon the retina is the 'juncture' at which a new kind of event, with its distinctive laws, comes into being. There is in this no incongruity with the hypothesis with which we are here concerned. For, whatever the mode of discontinuity, there would, according to that hypothesis, always be a definable condition, a critical point, at which the new method of action would begin; and thus the changes of laws would themselves exemplify law. Of course, if one knew the entire set of laws defining the junctures at which these shifts took place, and knew also the several specific laws, one would *then* be able—given also the necessary empirical information—to deduce what would occur in any particular case. But this would be a very different sort of logical situation from that exemplified by the astronomer's ability to deduce mathematically one of the components of the motion of a planet from the law of gravitation. In the former case, the only sort of law from which the various types of concrete events would be deducible would be, not a logically single law, but only a sort of catalogue, enumerating, one by one, the discontinuities between laws, and the junctures at which the discontinuities arise.

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[9] It is obvious, but perhaps prudent, to observe that any two laws, however discontinuous logically, can be *grammatically* unified by being expressed in a single complex proposition; but that this fact has nothing to do with the case.

It will, then, be seen from this that our hypothesis of an emergent evolution of laws differs from Peirce's not only by its abstention from the attempt to deduce uniformity from non-uniformity, law from lawlessness; it goes farther·and rejects the whole spirit of such an enterprise. For Peirce—and after him, in a more plausible manner, Boltzmann—proceeded from the assumption that even the fundamental characteristics of the world are susceptible of a sort of explanation—that, given merely an originally non-arbitrary condition of things, that is, the condition of maximal arithmetical probability, the necessity for all the empirical facts known to us could be deductively shown. The theory of emergent evolution, on the contrary, implies that no such deduction is needful or possible. It believes that certain solutions of continuity among natural laws are empirically observable; these it simply accepts—as Alexander and Lloyd Morgan are fond of saying—"with natural piety."

The principal sorts of 'juncture' at which it is abstractly *conceivable* that discontinuities with respect to laws of relative motion might occur—at which, so to say, nature might imaginably shift her gear—are four: (1) the mere completion of a period of time or of a number of repetitions of a process; (2) the attainment of a certain distance between the units of matter concerned; (3) the entrance of any such unit into some particular region of space(relative to a given set of coördinates); (4) the production, in consequence of prior motions in conformity with certain laws, of particular groupings or configurations of material units, which would thereupon remain integrated and begin to exhibit uniformities of motion of their own, not deducible from those which had previously held good of the separate motions of their components. Possible cases in the inorganic world which would serve to exemplify perhaps the first, perhaps the fourth, sort of juncture were mentioned by Campbell a few years ago in his lectures on *Stellar Motions.* After indicating the reasons for believing that stars of a certain spectral type (known as Class B and Class A stars) represent a very early stage of stellar evolution, Campbell points out that observation shows a surprising correlation between the spectral type and the velocity of stars, the Class B stars, for example, moving with relatively low velocity; and upon the consequent correlation of observed velocity with probable age he makes the following interesting comment:

> It is not easy to explain why the velocities of stars should increase with their effective ages, for we are accustomed to think of all matter as equally old gravitationally. Why should not the materials composing a nebula or a Class B star have been acted upon by gravitational forces as long and as effectively as the materials in the Class M stars? Are stellar

> materials in the ante-stellar state subject to Newton's law of gravitation? Does gravitation become effective only after the processes of combination are well under way? Is it possible that the gaseous matter composing a nebula is acted upon as effectively by radiation pressure as by gravitational attraction? The observed fact of the dependence of stellar velocity upon the spectral class is so new that these comments and questions make no pretensions to the status of a solution; but I am unable to suggest any other direction in which we should seek for explanation.[10]

I cite these tentative suggestions of Campbell only as illustrations of the nature of two of the modes of discontinuity I have defined, not as evidences of their reality or of the possibility of reconciling them with certain apparently well-established laws. If, however, some of these suggestions were accepted, we should be committed to the view that a law of motion once generally supposed to be universal and fundamental, in fact becomes operative only either (*a*) at a certain level of integration of matter, or (*b*) after a given integration has existed for a certain length of time.

Quite a different illustration—not a proof—of discontinuity at either the first or fourth type of juncture (or at both) may be seen in the theory of organic memory. According to certain writers—Semon, Bergson, Piéron, Samuel Butler, Russell, and others—'organic matter' has the distinctive peculiarity that it is in some degree altered more or less permanently by the changes that it goes through; the behavior of such a mass of matter at a given moment is a function of its previous history, not solely of its present configuration and of that of other masses, or of the present 'forces' acting upon it. Each repetition of a performance, according to this view, leaves the organism with a slightly different predisposition with respect to the manner or speed of its response to a given stimulus. The difference usually most emphasized by writers on these "mnemic phenomena" is that on the later repetitions a part of the original stimulus suffices to evoke the whole of the original response. We must then, Russell has declared, recognize two apparently distinct types of causation in nature, "ordinary physical causation" and "mnemic causation''; the latter is exemplified ''whenever the effect resulting from a stimulus to an organism differs according to the past history of the organism, without our being able to detect any relevant difference in its present structure.'' And it is this characteristic, Russell finds, ''that, more than any other, distinguishes the sciences dealing with living organisms from physics.'' In particular, ''if there are to be any purely *psychological* causal laws, they will have to be of the form not 'X causes Y now,' but—'A, B, C . . . in the past, together with X now, cause Y now.' ''[11] It would, of course, be difficult to show that there is in these cases ''no relevant difference in present structure''; only a complicated analysis could definitely establish even the probability of such a condition. It is for this reason that I here mention ''mnemic causation'' rather as a further sample of what a discontinuous emergence of laws would be, than as evidence that it actually has been. *If,* however, those theorists prove to be right who hold that this type of causation is radically distinct and that it is peculiar to living beings, then it clearly will follow that a given bit of matter at a given stage of stellar history would move in conformity with certain laws, and at a later stage (and presumably as a part of a different integrated complex) would move in conformity with other laws, not deducible from the first, and requiring for their expression the introduction of a class of variables wholly foreign to the first.

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[10] *Stellar Motions* (1913), pp. 37, 216.

It is, of course, the fourth sort of juncture that it is of chief interest to consider; most (not all) of the phenomena which tend to indicate a discontinuity of the laws of the movement of matter are such as to suggest that these discontinuities hold between persisting integrations of matter differing in the number or configuration of their components.[12] The issue concerning this mode of discontinuity is an old and historically important one, having been especially conspicuous in the philosophy and science of the late eighteenth century. In the traditional terminology it is the question whether there exist any material systems which are organic rather than atomic or mechanistic (in one of the senses of that ambiguous term) in their mode of action. An atomic system—to borrow a recent writer's formulation of distinction—"is one in which the laws of the parts composing the aggregate are not altered by the fact of their being parts of the aggregate, so that the laws of the aggregate as a whole are some simple function of the laws of the independent parts. An *organic* system on the other hand is such that the parts act differently when combined and in isolation, so that the law of the aggregate may not be a function of the laws of the separate parts at all."[13] This simple but important distinction was unfortunately entangled by Kant with the distinction between efficient and final causation; and it was further assumed by him, as by many others, that the organic type of system is to be found exemplified only in living beings. In other words, the term 'organism' as the name for a system characterized by a special mode of relation between the laws of action of its component units when in it and the laws of their action when outside of it, has been treated as equivalent to the term 'organism' as the name for those physical things commonly classified as animate. The two classes of 'organisms' may in fact be composed of the same individuals, but it is not self-evident that they need be; and it is quite possible that, in the former sense of 'organic,' inanimate organic systems exist. Some suggested instances have already been mentioned. The real issue, then, raised by the historic philosophical concept of organism is precisely the issue whether discontinuities in the laws of motion occur at what I have defined as the fourth type of 'juncture.'

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[11] *Analysis of Mind* (1921), pp. 82–90; italics mine.

[12] So even in the hypothetical case of organic memory: though the behavior of the organism is not supposed to be merely a function of its present structure, mnemic causation is nevertheless apparently assumed to supervene only in material complexes having a certain internal structure.

It will, perhaps, help further to avert misunderstanding of the hypothesis of the evolution of laws, if we recall an objection to it advanced by Henri Poincaré in the first essay of his *Der-*

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[13] A. D. Ritchie, *Scientific Method* (1923), p. 179. I regret to say that Ritchie adds at the end of the last sentence quoted, "or if it is, is a very complex function"—weasel words, which would destroy the useful distinction he is defining.

nières pensées. Poincaré's criticisms were evoked by a form of the theory put forward by his countryman, Émile Boutroux. But the reasonings of the great French physicist appear to be intended to apply, not merely to Boutroux's version, but to any version of the doctrine that "natural laws are susceptible of change," that "as the world continually evolves, the laws themselves, that is to say, the rules in accordance with which this evolution is accomplished, are not wholly exempt from variation." Such a conception, Poincaré declared, "has no chance of ever being adopted by men of science; in the sense in which they would understand it they could not accept it without denying the legitimacy and even the possibility of science." Still, he grants, "the philosopher has the right to examine the question" and to inquire whether such a hypothesis cannot, after all, be reconciled "with the legitimate demands of the scientific man." The chief reason which Poincaré gives for his own negative answer to this question is that no such alteration of laws in the past could now be empirically verified. Science reconstructs the remoter past solely by inferring from observed present effects to unobserved past causes; and such inference depends wholly upon the assumption that the relations of cause and effect with which we are now acquainted obtained at the time at which the particular effects in question were produced. "In short, we can know nothing of the past, except upon condition that it is admitted that laws have not changed. If we admit this, the question of an evolution of laws cannot arise. If we do not admit it, that question, like all others relating to the past, becomes insoluble.[14]

Now this objection may be—though I am not sure that it unqualifiedly is — pertinent as against such a conception as Peirce's or as Boutroux's. But against the hypothesis of the evolution of laws here under consideration the argument has obviously no force. For that hypothesis, it should be clear, implies that there may be present-day evidence of the past emergent evolution of natural laws. That evidence would consist in the occurrence, within our own experience, of different types of phenomena which could be brought under no one law, but would require for their correct description different sets of laws logically discontinuous *inter se.* If such a discontinuity, or irreducibility to ultimate unity, could be shown to obtain between the laws of the several classes of phenomena in question, that would not, of course, *directly* prove anything about the past. But it is quite conceivable that, by modes of inference common enough in science, we should find reason to conclude that, of these several classes of phenomena, some began to occur only at relatively late stages in the history of the system in which we are interested. If, for example, it should be possible not only to prove the discontinuity of the laws of the behavior of living matter and the laws of inanimate matter, but also to show that at some time in the past the temperature or other conditions now prerequisite to the existence of even the simplest forms of life were not realized, then, without flouting any "legitimate demands of the scientific investigator," we should have exhibited a probable case of the emergent evolution of laws.

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[14] *Dernières pensées* (1913), p. 10.

The hypothesis of emergent evolution is thus simply a form of the general doctrine to which M. J. H. Rosny and other French writers have given the name of 'scientific pluralism.' According to that doctrine, as one of these has recently put it,

> In all units, however small, of the physical universe, in all its aggregations, however vast, there is always heterogeneity, complexity; an intelligent and immortal being, possessing means of information endlessly perfectible, capable of progressing without obstacle towards the infinitely little and towards the infinitely great, would always find himself confronted with new differences, new multiplicities.[15]

To this the theory of emergent evolution merely adds that some of these blank diversities and discontinuities present themselves in a serial order in the history of certain material systems; the several types of now observable phenomena, between the characteristics and laws of which such irreducible differences subsist, have, it maintains, not always existed simultaneously, but have been added to one another gradually, the older types persisting along with the new and being interwoven with them in the total process of nature as we now experience it. The theory, in short, may be described as scientific pluralism viewed lengthwise instead of crosswise. The considerations pertinent to the two issues are in great part the same. It is, to be sure, possible, perhaps probable, that there are to be found in nature discontinuities, multiciplicities incapable of any unification, which cannot be shown ever to have 'emerged'; which, rather, appear, so far as our knowledge goes, always to have been there. Yet many of the discontinuities asserted by the scientific pluralist admittedly correspond to stages of cosmical evolution. The debatable question in these cases is not whether the several phenomena have appeared successively but whether the differences between them amount to real discontinuities. In the contention that they do, the believer in emergent evolutionism and the scientific pluralist must necessarily rely upon the same arguments. On the other hand, pluralism construed as an interpretation of evolution is in its conclusions a doctrine of much greater significance and interest than a pluralism which is interested only in exhibiting diversities and discontinuities in temporal cross-sections of nature. The former theory asserts a genuine progressiveness in the cosmical processes—in the sense, at the least, of an increase of versatility in nature's fundamental activities—as the presupposition of the otherwise incomprehensible diversification of her products and the ascending scale of *their* powers.

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[15] J. Sageret in *Revue Philosophique* (1923), p. 222.

While, as we have seen, neither the genus, scientific pluralism, nor the species, emergent evolutionism, actually contradicts any presuppositions indispensable to science, there is nevertheless a natural and not wholly illegitimate bias against both in the minds of many scientific men. The two great commandments of scientific reasoning are those which Whitehead has so happily summed up in five words: "Seek simplicity, and distrust it." But it is the first of these two that expresses the fundamental impulse and more characteristic craving of the natural philosopher. His warfare is to overcome the prima facie diversity and disconnectedness of the items of our experience, to show that phenomena which seem utterly dissimilar and unrelated are expressions of a single law. His moments of special triumph come when the simplifications which he has achieved by the correlation of things already verified in experience enable him to foretell things not previously verified in experience. Every unresolved discontinuity, all 'chasms' in nature, are frustrations of this urge to unify. Let us clearly understand what a thorough-going satisfaction of it would mean. It would mean that all the sciences were reduced to one science, and that that science contained only one law—a law relating to some clearly definable and exactly and uniformly measurable phenomenon, and declaring all cases of that phenomenon to be the same function of—at most—some very small number of independent variables, such, for example, as mass and distance. An approximation to this ideal would be reached if the two classes of units into which the material world has been resolved by that splendid achievement of recent science—the theory of the structure of the atom—were known to attract or repel one another at all distances in accordance with, say, a law of inverse squares; and if all atomic, molecular and molar motions, all the phenomena of radiation, all the processes of organic life, and all the acts of men (including those of men of science) were shown to be merely deducible instances of such attraction and repulsion in accordance with the one simple and unchanging law, the instances differing only in the numbers, distances, and masses concerned.

Science's millennial dream—which has often remained a somewhat vaguely defined dream—of such a complete unification has at times seemed to be in process of rapid realization; yet at other times it has suffered harsh disillusionments from experience, and scientific theorists have again and again encountered chilling reminders of the second and less grateful commandment of their law. To the philosophic looker-on at the arduous labors and astonishing achievements of natural science these disappointments are not surprising; for he remains mindful that a belief in the ultimate unifiability of natural laws has no cogent logical grounds. 'Seek simplicity' is a maxim born primarily of our needs and our ambitions—and most of all of the need for intellectual economy characteristic of such limited and short-lived creatures as we are. In advancing the dominion of man over nature science would make but slow progress if it were not possible to infer many actual events from a single postulated generalization, and to make one equation serve for the knowledge of a thousand facts. Yet we have no a priori assurance that the world is indefinitely accommodating to our intellectual convenience in this matter. As a distinguished astronomer has remarked, in spite of recent progress, "it is possible, even probable, that the universe considered as an object of science has its no-thoroughfares."[16] And even within ourselves we find impulses and interests at variance with the desire for an unlimited simplification of the picture of the world we live in. It may become so simplified as to be not worth living in—so simplified, indeed, as to imply the uselessness and even the impossibility of science itself. For we shall in the end, I think, find reason to suspect that there is something secretly suicidal for science in an unrestrained craving for the elimination of intrinsic diversity from nature, in the demand for a unification and simplification of knowledge so complete as to include the very activity of knowing. It may be that at the full consummation of that enterprise science would be found in a curious and tragic logical posture—lying

> Like a god self-slain on his own strange altar.

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[16] Nordmann, *Einstein and the Universe* (1922), p. 44.

III

So much by way of suggesting the meaning of our question, the issues involved in or related to it, and its philosophic significance. It remains to inquire whether we have any means of reaching a reasoned conclusion on the question. It will be observed that the failure of natural philosophy at a given date to bridge all 'chasms' or to reduce one science to the categories and laws of another, is not of itself conclusive evidence that such unification is impossible. Progress towards the unification of science takes place when, through some effort of the scientific imagination, a postulate is framed which makes it possible to recognize in seemingly diverse operations of nature merely quantitative or configurational variations upon a single theme—to perceive that nature's bag of tricks is not really so various as it had appeared to be. Since the essential unity may be there even when we have not yet apprehended it, our inability to find it is no proof of its non-existence. Nevertheless, even a Scotch verdict on the matter would be not without value, as a discourager of certain kinds of dogmatism. And it is not inconceivable that we may find discontinuities so broad and deep between some modes of motion of physical things that we may with a good deal of confidence conclude that no future effort of the synthetic imagination will be able to remove them.

I shall attempt to present only one decisive example of such discontinuity, an example to be found in certain motions or components of motions of the material complexes called human bodies. But before proceeding to this crucial instance, it is perhaps worth while to touch upon the present state of the question in two other of the provinces of science—even though what is said concerning at least one of them must be frankly inconclusive.

1. In the existing state of scientific knowledge, are there indications in the inorganic world of discontinuities in the laws of the action of matter, at any of the types of juncture already men-

tioned? Upon such a question an extremely ignorant layman in this field can only very diffidently and tentatively venture an opinion; and I put the question chiefly in order to suggest that it is one to which some philosophers would like to have a comprehensive and methodical answer from a competent physicist or physical chemist. The philosopher is interested in this question especially for two reasons. The answer to it would, in the first place, tend to throw light upon a very significant characteristic of the temporal world; it would be a provisional generalization touching a matter so fundamental and important concerning the ways of nature that it would be in itself a philosophical conclusion. And in the second place, the contemporary philosopher has reason to desire an answer to the question, from those qualified to speak upon it with authority, because in a good deal of current discussion in other fields—in theoretical biology and psychology, in epistemology and in metaphysics—conclusions often seem to be based, expressly or tacitly, upon a general presumption of continuity which is supposed to have the weighty sanction of the more exact physical sciences. The absence of discontinuities in the laws of the infra-organic or the infra-conscious worlds would, of course, be no real proof of continuity between the former laws and those of living or of intelligent beings; but the admitted *presence* of discontinuities in inanimate nature would tend to weaken preconceptions that sometimes play a decisive part in the formation of opinions on other issues of very immediate interest to the philosopher.

Now—if a layman's impression on the question may be hazarded—it seems plain that, though two immense steps toward the seeming unification of science have been achieved within the past two decades, we are still a long way from the elimination of all discontinuities between the laws of inorganic processes, or from a proof that all are capable of elimination; and the apparent effect even of some of these new partial unifications is to make previously unsuspected seeming discontinuities apparent at other points. Of the two steps to which I refer, the first is that made possible by the genius of Einstein. The special theory of relativity apparently permits us to bring together into a single deductive system an enormous collection of facts belonging to the several branches of mechanics, to optics, hydrodynamics, and elasticity. The general theory of relativity reduces the laws of gravitation and inertia to one, i.e., shows that both phenomena can be regarded as manifestations of a single property of matter—or, as some would prefer to say, of energy. The result of the two theories together is thus a marvelous simplification of the principles of physics. Yet this great stroke, or series of strokes, of unification has certain peculiar aspects which should not be overlooked. In the first place, its empirical starting point consisted in the experimental discovery of a most amazing apparent discontinuity—of the first type above distinguished—in the laws of motion. It had seemed to be conclusively established by experience and, as many held, to be also intuitively self-evident, that the law of the composition of velocities is universally valid—i.e., that when two different velocities in the same direction are imparted to a body, it will move with a velocity equal to the sum of both, as in the familiar experience of walking forward in a moving train. But the experiments of Fizeau and especially that of Michelson and Morley seemed[17] to show an exception to this supposedly well-established and indubitable law. When one of the two moving things is a ray of light, it was found that the velocities are not in fact compounded. The rate of motion of the light relatively to a given observer is precisely the same whether he is advancing to it or receding from it. Einstein's first great achievement was to overcome this discontinuity by a new synthesis, to restate the laws of motion in such a way that this fact no longer appeared as an exception to the prevailing uniformities of nature. But a breach of uniformity here was avoided only by boldly introducing non-uniformity of another type elsewhere in nature, on a tremendous scale. The new theory met the difficulty presented by the Michelson-Morley experiment by making *all* the ordinary metrical properties of physical processes vary with the state of relative motion of the observer. Its unification, in short, presupposes a prior plurification (if I may coin the word) of a drastic kind—namely, of the very standards of measurement in terms of which physical laws have to be stated. In the Newtonian universe there were many things which remained the same in all places and under all conditions. Time flowed evenly everywhere; mass and volume were unaffected by velocity; between any two points there was just one, definite, unequivocally measurable distance. Most of these invariants of Newton's world have disappeared in that of Einstein, being sacrificed to the necessity of preserving the invariance of the relative velocity of light. There is no longer a single time, but only a multiciplicity of local times; there is no single exclusive set of true quantitative propositions that can be made concerning the velocity, the mass, the size, even of what is described as an identical material entity. So, again, the general theory simplifies mechanics by geometrizing it; but it complicates geometry by substituting for the uniformity, the tidy smoothness, of Euclidean space, a space that grows kinky, in varying degrees, wherever there are gravitational fields. Behind all these new and formerly unsuspected diversities there also appear new and impressively sweeping uniformities, in the Einsteinian description of nature. But the kind of unity that results is of a different sort from that which appears to have been conceived of by many of those who have been wont to talk enthusiastically of the unification of science. It differs markedly from the unification, within narrower limits, brought about by Newton's discovery of the (approximate) law of gravitation. That made it possible to regard modes of motion sensibly most diverse as (in part) manifestations of a single 'force' or a single property of matter. But it did not upset fundamental uniformities previously taken for granted; nor did it reach its simplification through a sort of preliminary distintegration of the system to which it was applied.

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[17] I say 'seemed,' because the experimental proof does not as yet appear to be rigorously demonstrative, in the sense that all other conceivable explanations of the observed data are definitely excluded.

The strictly universal, absolute, and uniform laws of nature, in the special theory of relativity, apply only to the four-dimensional magnitude called an 'interval'; with respect to the distribution of the components of such magnitudes between the one time- and the three space-dimensions—that is to say, with respect to those quantitative attributes of the world with which we are concerned in ordinary experience—it asserts not merely a degree but a kind of diversity or disparateness previously undreamed of.[18]

However, it remains true that a large measure of unification is the result; these strange diversities do not amount to discontinuities, in the sense earlier defined, since they can all be correlated and made to fit into a potentially deductive system. But this system, *qua* deductive, is by no means all-comprehensive, as may be seen from the fact that the second great synthesis achieved by recent physical science was not reached, and apparently cannot be reached, by deduction from the first. This second achievement is, of course, the theory of the structure of the atom, which actually reduces the science of chemistry, with respect to its fundamental conceptions, to physics, and unifies another wide range of previous unconnected physical facts. Yet here especially, new discontinuities seem to come to light along with the new identities. For example, we are told upon the high authority of Sir Ernest Rutherford that while it has been experimentally shown that "the law of the inverse square holds at any rate approximately for the attractions and repulsions of the electrons" in the nuclei of certain atoms, "this law breaks down in close collisions of light atoms, where the nuclei approach very near to one another," and that in the oxygen atom, where the protons and electrons are relatively closely packed, "it seems clear that the forces between the charged units at such small distances must be different from that of the inverse square."[19] Supposing this to be the case, we should have for the positions or accelerations of the units within the atom one law holding good up to certain limits of distance, and then giving place to another law, without any known alteration in any circumstance except the distance itself. So again Sir J. J. Thomson assumes that in any atom "the law of force between the positive charge and an electron" is a "complex one which changes from attraction to repulsion as the distance between the positive charge and the electron diminishes," and that the distance at which the force changes from attraction to repulsion "varies from one kind of atom to another."[20] These may very well turn out to be merely provisional results; but so far as they go, they seem to suggest discontinuous jumps occurring at certain 'junctures,' from one uniformity of relative motion to another in no way deducible from the first, or from any other yet known or conjectured law. Further examples of seeming discontinuity could, if I am not mistaken, be adduced from contemporary physical theory. It seems, then, to be by no means true that recent scientific progress has reduced, or has come near to reducing, all the movements even in the inanimate world to a single law, or mutually implicatory set of laws, expressed in terms of a few universal variables. We cannot say here that complete unification is impossible or even manifestly improbable; but we must still say that it is unproved, and that, therefore, the sciences of the inorganic do not, even in their own domain, establish a strong presumption against the hypothesis of the emergent evolution of natural laws.

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[18] How this is in the last analysis to be interpreted depends upon the view taken concerning the metaphysical import of the doctrine of relativity—a large and controverted question which it is not possible to discuss within the limits of this lecture.

[19] Art. "Matter, Constitution of," *Ency. Britannica,* XXXI (1921).

(2) Is there, in any case, a "chasm between the organic and the inorganic," as Professor Howison suggested; i.e., do physiological processes or the phenomena of 'behavior' in the lower organisms give evidence of any discontinuity in the laws of the movement of matter? Upon this vexed question also I shall not here attempt conclusive argument. Any adequate treatment of the subject would necessarily be lengthy; but there are certain confusions which infest the current discussion of it, and one or

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[20] *The Electron in Chemistry* (1923), p. 4.

two of these can perhaps be briefly cleared away. (*a*) The question at issue, it is evident from our previous analysis, is whether all the movements or combinations of protons and electrons in a living organism—and consequently all the movements of the organism as a whole—are deducible from the same law as describes all the other movements, in other integrations, of those ultimate units of matter; whether, e.g., their movements within the organism are, without exception, the *same* functions of their masses and distances as in separate atoms or molecules. If they are not, there is obviously a discontinuity somewhere, though the juncture at which it occurs may conceivably lie below the level of animate matter. Now the organic processes are obviously not *in fact* so deducible at present. The biologist has not yet had his chief problems solved for him by the new theory of atomic structure. And it is a fallacy to suppose that any evidence of the ultimate possibility of such deduction is afforded by a proof that all physiological processes are functions of the physico-chemical composition and structure of the organism. That the laws of organic action can be stated in physico-chemical terms—i.e., can be expressed in the same types of variables—may be recognized without at all implying that these laws are completely identical with the laws of other physico-chemical complexes. And it seems to me fair to add that the burden of proof, an exceedingly heavy burden, rests upon those who assert such identity. When one considers the phenomena exhibited by animate matter—assimilation, cell-division, organ-formation, the interdependence of functions of organs, reproduction, heredity, regeneration of organs and maintenance of specific form after amputations, learning by trial and error, etc.—one is bound, I think, to feel that there is a great antecedent probability against the hypothesis that all these extraordinary performances of protoplasm are merely consequences of a single law, or even a pair of twin laws of attraction and repulsion (e.g., laws of inverse squares) between electrically charged units, such as is equally exemplified in the behavior of all other substances, even the most inert. Nor does the progress of biological investigation tend to remove this improbability; while biologists have made notable discoveries of *special* laws of the behavior of living matter, the advance of their science constantly discloses new evidences, or seeming evidences, of the idiosyncrasy of the action of such matter. On such a point, no doubt, a non-specialist is hardly entitled to express an opinion upon his own authority; but there is abundant testimony to this effect from biological investigators of unchallengeable competency. It was, indeed, some two decades ago that E. B. Wilson declared that "the study of the cell has on the whole seemed to widen rather than to narrow the enormous gap that separates even the lowest forms of life from the inorganic world";[21] but—to mention no others—J. S. Haldane has within the past year still more emphatically affirmed the same conclusion. "It was," he writes, "only through the prevailing ignorance of physiological facts that the physiologists of the middle of the last century imagined that they were approachiing a physico-chemical solution of elementary physiological problems. . . . The work of generations of highly trained physiological investigators has resulted in a vast increase of physiological knowledge, but has also shown that physico-chemical explanations of elementary physiological processes are as remote as at any time in the past, and that they seem to physiologists of the present far more remote than they appeared at the middle of the last century." With respect to heredity, Haldane goes even farther: "The mechanistic theory of heredity," he declares, "is not merely unproven, it is impossible. It involves such absurdities that no intelligent person who has thoroughly realised its meaning and implications can continue to hold it."[22] Certainly when any competent physiologist can write in this fashion, a philosopher may legitimately believe that there is at least some presumption, in the present state of our knowledge, against the assertion of the continuity of the laws of the organic and the inorganic—that the bridging of this chasm is not only unachieved but improbable.

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[21] *The Cell in Development and Inheritance* (ed. 2; 1900), p. 330.

[22] *Mechanism, Life and Personality* (1923), pp. 46 ff. By "physico-chemical explanation" I understand Haldane to mean reduction to the same physical and chemical laws as are exemplified by non-living matter. That the distinctive laws of physiology can be formulated in physico-chemical terms, he does not appear to deny.

(*b*) The belief—which has been held, undeniably, by some eminent biologists—that progress has been made toward the establishment of such continuity, seems to be due largely to a further confusion of ideas—namely, to the supposition that the *artificial* production in an organism of any physiological phenomenon proves that phenomenon to be identical in the law of its occurrence with extra-organic chemical processes. Thus the late Jacques Loeb apparently regarded the artificial fertilization of the egg of the sea urchin as a great step toward the reduction of vital processes ''to a physico-chemical explanation.'' This expression, as I have already intimated, is ambiguous; but if it meant the establishment of a deductive continuity between any law of general physics or chemistry and the phenomenon of fertilization (with its consequences), one can only say that the discovery in question obviously did not even tend to establish any such continuity. It is, again, frequently assumed that if a synthetic chemist should some day manufacture in his laboratory a compound having the properties of protoplasm, biology would thereby be resolved into chemistry, the doctrine of the essential uniqueness of the behavior of living matter would be once for all refuted, and the hypothesis of emergent evolution would break down at one of its supposed strongest points. The slightest reflection should suffice to make it evident that nothing of the sort would follow. The new colloid would, by hypothesis, behave in the manner previously characteristic of natural organisms; and there would consequently be just as much (or just as little) reason as there was before for affirming the 'autonomy' of vital phenomena. All that would be proved would be that the critical juncture at which the apparently new laws of life supervene upon the laws of inorganic matter is a juncture which can be produced by intelligent human agency. There is nothing in the principles of scientific pluralism or of emergent evolutionism which requires a denial that it can be so produced; on the contrary, these principles would rather incline one to conceive that such an achievement may not be impossible, and, in any case, to regard as curious aberrations of great scientific minds the ingenious hypotheses which have been devised solely in order to avoid admitting the spontaneous generation of life at some remote past juncture in stellar evolution.

(3) These, however, are matters beyond my province; and I have perhaps dwelt too long upon them. Let us pass to the class of natural entities in which the question of the discontinuity of the laws of motion can best—as it seems to me—be brought to a crucial issue. It is the class consisting of those material systems called human bodies. These, like all other matter, we must suppose to be integrations of molecules, which are integrations of atoms, which are integrations of electrons and protons. Many of the minute molecular processes occurring within these bodies, certain of the component forces affecting their motions, plainly act in conformity with the same laws as are expressed in the movements not only of all organisms but also of non-living matter. Is there, however, a residuum of the unique and irreducible in the behavior of these aggregates? Certainly they sometimes seem to act in odd ways. The mass of molecules, for example, which constitutes the hand of an Einstein, sets down on paper a series of equations which lead to the prediction, quantitatively precise within narrow limits, of a future event—and sets, or seem to set, groups of molecules known as astronomers moving thousands of miles from California to the spot in Australia where that event happens to be best observable. Do such phenomena as these exemplify simply the uniformities of attraction and repulsion, statable in terms of mass and distance, which were already manifest in the driftings of primeval star dust or the revolutions of the electrons of the uranium atom about their nuclei? Have we reason to believe that an Einstein or a super-Einstein yet to come may be able to formulate a single law, or a set of geometrical postulates, from which it will be possible to deduce with equal

precision not only the behavior of light waves, but also his own deduction of their behavior—or at least the material part of it, the movements of the muscles and of the pen, the shapes taken by the lines of ink upon paper, as the equations are written down?

Certain considerations there are—practical or 'pragmatic' considerations, certainly, but not on that account less cogent ones—which seem to me to make possible an answer to this question. There is one postulate which lies at the base of all experimental inquiry, of all applied science, indeed, of all that we call civilization. It is the assumption that intelligence is capable of being a factor in the control of human action and thereby of man's physical environment. 'Taking thought makes a difference'—that is the necessary assumption of every man who applies reason to the shaping of any of the issues of life, small or great. If *that* posulate, at least, be not true, universities are absurdities and laboratories are costly monuments of delusion. For any experiment deserving the name is an experience planned beforehand; it presupposes the selection through human prevision, and under the control of considerations of logical relevancy to an hypothesis, of the conditions under which some physical event shall happen. Now of all intelligent or planned action the essence is adjustment to future situations, the determination of some present particular arrangement of bits of matter partly through its relation to some other particular arrangement of other bits of matter which does not yet exist, as well as to a present purpose of some finite individual. If it is admitted that there ever occurs any successful application of intelligence to the control of any course of external events, this can mean nothing less than that *some movements of certain complexes of protons and electrons are, in part, functions of other movements which are to occur afterwards.* And this determination of some character of a present motion by some character of a yet unrealized future is a conception obviously foreign to the laws of physics and chemistry; in the formulation of the correlations of the motions of electrons within an atom, or of those of the molecules of a gas beating against the walls of a container, no such reference to future situations is found to be requisite; and it is in fact, incongruous with the most fundamental methodological assumptions of those sciences.

I am not at present, be it understood, offering arguments in favor of interactionism or of any dualism of mind and body. I believe that no realistic philosophy can avoid such dualism without contradicting plain facts of experience and necessary presuppositions of science. But that issue is not the one just now before us. We are concerned, not with the question whether there are two radically distinct kinds of entities or activities, mental and physical, but with the question whether there are (at least) two radically distinct kinds of causal law exemplified in physical processes, i.e., in the movements of matter—one set of laws in the formulation of which the only variables which are admissible are prior or simultaneous physical events or situations, another set in which *possible or actual physical events subsequent to the occurrence of the phenomena to which the laws relate are among the variables in concomitance with which the laws declare such phenomena to happen.* Common sense is accustomed to suppose that such shaping of some features of the present by the future can occur only through the mediation of a peculiar sort of *present* phenomenon, whereby situations that do not yet exist in the physical world are non-physically represented, or rather pre-presented. But upon the indispensability of this mediation I do not on this occasion insist. My contention is only that—however the thing is done—future arrangements or movements of matter must be regarded as somehow capable of having a part in determining, in a distinctive way, present movements of human bodies and of the other bodies which they are able to set in motion, or else we must admit that the power to foresee happenings in the physical world is an absolutely useless redundancy in nature and in human life; and that, since the latter alternative is inadmissible, the former must be adopted. And this conclusion may be, and, indeed, has been, accepted by philosophers who reject, or at any rate believe themselves to reject, psychophysical dualism—who are, in short, in the traditional sense of the term, materialists. For example, B. H. Bode, who has been led through pragmatism to an extreme form of the doctrine known as behaviorism, is emphatic in the denial of a duality of substances. ''We do not find body and object and consciousness,'' he writes, ''but only body and object. . . . . The process of intelligence is something that goes on, not in our mind, but in things.'' There are no facts, in psychology or elsewhere, which require a ''subjectivistic'' or ''psychic interpretation.'' Yet the philosopher who thus unequivocally accepts the extreme behavioristic creed sees clearly that there is something irreducibly distinctive about the sort of behavior that we call intelligent. Though there is no immaterial stuff such as the word ''consciousness'' has usually stood for, there *is,* he finds, a unique mode of action of certain physical complexes, to which—since some verbal means of distinguishing it from other physical phenomena is needed—the name of ''consciousness'' or ''conscious behavior'' may be transferred. And the differentia of this mode of action of matter is ''the control of conduct by future results or consequences.'' In intelligent response to stimuli ''a contingent result somehow becomes operative as a present fact; the future is transferred into the present so as to become effective in the guidance of behavior.'' ''The whole mystery of consciousness is just this rendering of future stimulations or results into terms of present existence.'' ''If we refuse to recognize the advent here of a new category, intelligence becomes an anomaly and mystery deepens into contradiction.''[23]

That it is possible to stop with these conclusions of Bode's I do not believe. That he does not render it intelligible that future results should, or evident that in human experience they actually do, determine present effects without prevision of those results, i.e., without the functioning of consciousness (in the usual sense of that term), I have elsewhere attempted to show.[24] But as behaviorism is at the moment a good deal in vogue, it has seemed worth while to cite his reasonings as showing that the chief argument for the emergent evolution of laws of motion can be stated in the behaviorist's terms, and that a writer wholly free from any bias towards subjectivism or psychophysical dualism can recognize the force of that argument. Bode does so because he is loyal to the elementary but sound principle which is at the heart of pragmatism—the principle that knowing is a practical thing, that intelligence makes a difference—and because he is unable to conceal from himself the philosophical implications of that principle.

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[23] Bode, ''Consciousness and Psychology,'' *Creative Intelligence,* 1917, pp. 232–251 and *passim.*

To the admission that in human behavior anticipated future situations are somehow factors in determining present action, the usual alternative proposed is a certain form of psychophysical parallelism. The molecular movements or energy transfers occurring at a given moment in brain or nerve, the parallelist of this type usually tells us, are wholly determined by the immediately antecedent configuration of particles within and without the body; in formulating the laws of their occurrence, and the consequent laws of human action, no reference to future situations is necessary or permissible, for man would behave in precisely the same manner if he had no ability to foresee the future. It happens, indeed, that he has this ability, that images of events yet to come arise in association with certain molecular processes in the cortex. And this gift of prevision, the parallelist explains, begets in men a delusion of power; they conceive that by taking thought for the morrow they can in some measure determine what the morrow shall be. But the thought as such—even foreseeing thought—is a pure irrelevancy; it is the fly upon the chariot wheel, it is the buzz that accompanies the whirling of the bodily mechanism.

This challenge to the belief in the pertinency of planning, in the utility of forethought *as* forethought, we must, then, consider.

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[24] "Pragmatism and the New Materialism," *Journal of Psychology*, 1922, pp. 5–15.

It is evident at once that the parallelistic doctrine does not, upon any reasonable interpretation, avoid implying one sort of emergent evolution. For the parallelist plainly admits the reality of a non-physical entity or process which could scarcely be supposed—even by one who attributed to all matter an accompanying consciousness—to have been associated with all phases of the evolution of a solar system. Perhaps the electrons in the uranium atom have a rudimentary sentiency; certainly it would be difficult to prove the contrary. But it seems improbable that they are able to foresee remote future events. And by merely describing the grouping in space, even in the most complicated manner, of a large number of moving and sentient units which have severally no foresight, you have obviously not described a case of foresight. If the foresight arises, on the occasion of such configurations, it is obviously as an emergent.[25] And that delusion of power from which non-parallelistic philosophers and most of the rest of mankind are supposed to suffer—whence is it? Has it also existed throughout cosmical history? The parallelist must either maintain that it has, or recognize in it, at least, a novelty—presumably, in his view, an unfortunate novelty—which at some time or other made its first appearance upon the cosmic scene.

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[25] It seems to be held by many that the combination of parallelism with panpsychism makes it possible to avoid the admission of emergent evolution. The most recent expression of this view is by Carveth Read. He postulates ''the universality of consciousness in Nature'' simply in order to exclude discontinuity. ''As the organic is built on the inorganic, there is no accounting for consciousness in the former unless in the latter it was already present.'' ''If we admit the principle of continuity (*ex nihilo nihil*) for consciousness as we do for the processes of the physical world (and if not, why not?) there is no escape from the alternative of regarding consciousness as an universal activity of Being, which accompanies'' even ''inorganic changes'' (*Contemporary British Philosophy* (1924), pp. 335, 337). But the same argument, surely should compel the panpsychist to regard ''as universal activities of Being'' various ''higher degrees'' of consciousness which certainly do not differ from the lower ''degrees'' in a merely quantitative way, i.e., are not simply multiples of elementary sensations. Such higher modes of consciousness are associative memory, self-consciousness, logical reasoning, prevision. The panpsychist, in short, is half-hearted and inconsistent in his application of the ''principle of continuity.'' If he is unwilling to regard *both* sentiency and intelligence as accompanying all motions of matter, he has no reason to attribute such ubiquity to sentiency, or mere ''consciousness,'' alone. Even if consciousness were assumed to be in all its modes essentially the same kind of event, a mere undifferentiated act of apprehending, the difference between its ''degrees'' consisting solely in the *amount* of the content of the real world that is apprehended—there would still be implied an emergent evolution. For the increase in the grasp of consciousness would be a pure addition to previously existent reality—not a bare re-arrangement of the pre-existent. The differing configurations of molecules with which it was associated might be re-arrangements; but since, on parallelistic principles, it is not identical with nor caused by them, the enlargements of apprehension arising at certain junctures would be essentially epigenetic, and not mere variations of phase of a quantitatively uniform total.

However, this supervention of new non-physical entities or activities would not be the type of emergent evolution with which we are here concerned. The question pertinent to our present inquiry is whether psychophysical parallelism offers a really available way of escape from the admission of an emergence of new laws of motion in certain material complexes, at whatever point in evolution intelligent behavior first appeared. What parallelists often tell you is that they too in a real sense believe in the utility of planning. For though, as a mere process in consciousness, planning is without efficacy, every least detail of it, they maintain, has its specific physical correlate which *is* efficacious. An example of the argument may be quoted from an able and ingenious defense of the double aspect form of parallelism.[26] As a parallelist, Professor Warren, the author of this defense, has, unlike Professor Bode, no objection to dualism; he is willing to recognize the reality of subjective "ideas," of which some are "forethoughts." He expressly recognizes also that "in purposive acts the temporal order noted in causation in some way becomes inverted. . . . . In such a series of acts the present 'hangs upon' the future, or is 'determined' by it. The relation of terms in such a series is radically different from that in the ordinary causal series, the distinctive feature being a partial inversion of the temporal order." Yet in spite of these apparent admissions of the uniqueness of purposive action, Warren still feels obliged to hold fast, at least tentatively, to "the mechanistic standpoint"—the view "that all modes of activity, organic and inorganic, are ultimately identical, that all may be formulated in the same general terms," and that therefore in the end we should be able "to express all the activities of organisms in 'physico-chemical' terms. . . ."[27] He therefore will not entertain the hypothesis of ideomotor action. "Whatever the character of the forethought, whether it refers to a motor act or to the solution of a mental problem, our belief that it actually has power to produce the result is an anthropomorphic interpretation of a psychological datum." Yet our parallelist denies that this "reduces consciousness to the rôle of an epiphenomenon," or makes purposive thought nothing more "than a passive spectator of the physical changes which constitute real activity and form the basis of history." The objection may, he grants, "hold as against the traditional parallelistic worldview, but it loses force if we adopt the double-aspect standpoint." According to the latter view, "one set of occurrences is as 'real' as the other." "Our thoughts and purposes are only our way of experiencing what an independent observer might perceive as physiological activity." But—aside from an ambiguity in the whole conception, of which I do not here speak—it is to be noted that one of the two "sets of occurrences," namely, the mental, contains a "future reference," and that the other, the physical, does not. Now if the latter occurrences pursue their independent—though mysteriously parallel—course, the future reference is no factor in *their* behavior; in other words, intelligence has no pertinency to any physical event. Surely it is an odd delusion to imagine that, if you merely assume all the processes of intelligent prevision to be temporarily coincident with, though incapable of affecting, certain other processes innocent of intelligence and prevision, you have thereby affirmed the practical potency of intelligence. It is much as if one had argued, before the adoption of woman suffrage that all married women had votes, because they had husbands who had votes. Not even, then, in the so-called double-aspect variety of parallelism does there seem to be any room for the efficacy of intelligence.

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[26] H. C. Warren, "A Study of Purpose," *Journal of Philosophy,* 1916.

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[27] H. C. Warren, "A Study of Purpose," *Journal of Philosophy*, 1916. It should perhaps once more be pointed out that formulating all modes of activity "in the same general terms" does not necessarily mean reducing them to the same law.

The writer quoted, it is true, would apparently take exception to the term efficacy; for he thinks that any such criticism of his view is "based upon an unscientific" or "anthropomorphic conception of natural events," whereby we erroneously "attribute power to causation and *selective potency* to purpose." But the criticism is in fact based upon no such conception. It merely asks whether the presence of intelligence, the occurrence of forethought among the antecedents of some physical events, makes any difference whatever in the character of those events. To assert the efficacy of intelligence is to assert that where that antecedent is found the physical consequents, i.e., those apparent to an "independent observer" are in some degree other than what they are, or would be, where it is absent. No delicate abstention from the use of the word 'power' will enable even the double-aspect theorist to escape the alternative of either accepting or not accepting that assertion. If he accepts it, he has admitted all that is necessary for the present argument; if he does not accept it, he plainly refuses to attribute to purposive thought any rôle beyond that of "passive spectator of physical changes"; if he denies it, he affirms that when man, or some lower animal, first acquired the power to foresee and the impulse to plan, he gained nothing which could in any way modify his action or his environment.

There is, however, a possible objection which may occur to some at this point. Any purposive act can undeniably be described correctly, though not completely, without any reference to forethought. If a man always carries an umbrella when the wind blows from a certain quarter, say the south, you can, if you like, express this fact simply as an ordinary sequence of antecedent and consequent — umbrella-carrying consequent upon south wind—without mentioning that there is involved in the affair a forecast of rain and a provision of protection against it. This is merely an instance of the obvious general truth that, if there be any apparently fixed sequence of events, A B C D E, you can discover and formulate a provisional law; 'A is followed by E,' without saying or knowing anything about B C D. This, however, does not mean that you have shown that A would in fact be followed by E if B C D were in fact eliminated from the sequence — a truism which some contemporary psychological theorists seem to forget. While, in the case of the prudent umbrella carrier, the observable uniformity in his behavior can be stated in strictly physical terms without attributing to him any intelligence whatever, the question remains whether it is the *same* uniformity as would be observable if he had really had no intelligence. To express this general consideration in the terminology which I have been employing in this lecture: Let it be supposed that, of the instances of a given type of phenomenon P, some, which we will call P_1, occur in conformity with a law A, and the rest, which we will call P_2, occur in conformity with another law, B; but that the shift from A to B takes place uniformly at a definite juncture, X. Now the appearance of the juncture X will itself be an event occurring in conformity with law A; and it will therefore be possible to discover empirically (but not to deduce from A) a third law, C, *relating solely to the temporal sequence between X and any instance of* P_2, in which law no mention need be made of the law B. If—to repeat an illustration already used—the attraction of the two moving particles varied with distance, up to a critical distance N, in accordance with a law of inverse cubes and at nearer distances in accordance with a law of inverse squares, we should be able, first, to deduce the attractions of given particles by means of the former law up to the distance N; and second, to ascertain empirically that at any time after the distance N is reached the attraction is always of a certain magnitude, M. But this obviously would not mean that the class P_2 has been reduced to the class P_1, in other words, that M conforms to the law of inverse cubes. Nevertheless, a good deal of the so-called 'reduction' of one class of phenomena to another seems to me to consist in precisely this sort of reasoning: i.e., in a proof that a given juncture arises in accordance with a known 'mechanical' law, and that some other event happens in a uniform manner subsequently to that juncture—the erroneous inference being drawn that the latter event exemplifies the same mechanical law.

To return, now, to the parallelist: One of the forms of purposive thought to which (though he usually does not mention it) he is compelled to deny all efficacy is the purpose of conveying thoughts to others through spoken or written speech. He cannot in consistency suppose himself to be capable of 'expressing' ideas; for though the ideas may be in his consciousness, they have, according to his theory, no part in causing the movements of the vocal organs, or of pen and ink, or of any of the so-called instruments of communication between men. An unefficacious thought obviously can have no 'instruments.' It is true, of course, that the parallelist would presumably add that through the operation of mechanical forces of attraction and repulsion between protons and electrons, there will be produced audible sounds or written characters which happen to be accepted symbols for the thoughts that have been passing through his consciousness; but this uncaused coincidence is merely one of the numerous miracles which his system requires him to accept—perhaps the miracle of miracles. The paradox inherent in such a view strikes one with especial force in the case of an epiphenomenalist who, like Santayana, is also a master of the art of expression. In an often quoted passage, Santayana assures us that the belief "which attributes to thought a power, by virtue of its intent, to bring about what it calls for, as an incantation or exorcism might do," is merely "a superstition, clung to by the unreconciled childishness of man. . . . . The consequences of reflection are due to its causes, to the competitive impulses in the body, not to the wistful lucubration; for this is mere poetry. . . . . Consciousness is a lyric cry in the midst of business." In Santayana's own wistful lucubration when devising this rhetorically effective way of putting his contention, was he entirely uninfluenced in his choice of words by a consideration of the relative suitability of alternative verbal vehicles for conveying to others his meaning and his emotion of conviction? Did it never occur to him that he was choosing means to accomplish an end, which means certainly would not accomplish it so long as they remained purely states of his consciousness? Did he really believe that his pondering of word values, of similes, or of cadences, was wholly irrelevant to the determination of the characters that were presently to appear upon the printed page? I find it impossible to suppose so. Good writing is usually an exercise of choice based upon intelligent prevision; and no such exercise is possible in any form without a belief that the situation foreseen is one to which adjustment can conceivably be made, and that such adjustment, if made, would mean the occurrence of a natural event other than that which would have occurred in the absence of the prevision.

Parallelism, then, seems able neither to overthrow the presumption of the pertinency of planning to the determination of some physical events, nor to reconcile that presumption with the dogma of the identity of the modes of motion of bodies involving intelligence with the modes of motion of all other bodies. We thus remain under the necessity of adopting one or the other of the two conclusions already indicated: either there has emerged in the course of evolution a specific psychic process called forethought, which accompanies or follows upon certain specific physical processes in the brain, and modifies in some manner the subsequent physical processes in the neuro-muscular system, and indirectly the motions of external things; or else we must try to conceive of certain late-evolved integrations of matter as themselves, without the aid of any psychic phenomena whatever, somehow taking account of future events and having their motions modified accordingly. In one way or the other, anticipated future events must actually function among the conditions determining present physical events—or else the practical intelligence has *no* function, and in all his experimenting and all his planning man walketh in a vain show and disquieteth himself in vain. To reject both alternatives, in short, is, in the name of the unity of science, to proclaim the futility of science.

An excessive and undiscriminating faith in the unifiability of knowledge, an unwillingness to recognize in any domain of nature any distinctive laws and unique categories, has, in fact, led some contemporary theorists, especially in psychology, into a curiously paradoxical position. Wishing to reduce the science of man to methods and principles already established in, and adequate for, the sciences not concerned with man, they have reached conclusions implying either the impossibility or the uselessness of there being any such creature as a man of science. I have on a previous occasion in Berkeley pointed out that a doctrine widely influential in contemporary psychology has for its unmistakable, though not always recognized, logical consequence the proposition that no man, not even a psychologist, ever knows anything.[28] The kindred doctrine of the parallelist adds—explicitly or implicitly—that if a man ever does know anything, the knowing has no influence upon his behavior or his fortunes. No human being, of course, ever consistently and habitually believed and acted upon either of these propositions. Nevertheless, they figure conspicuously in certain contemporary philosophies; and one of them is the theoretical basis of a type of psychology which—though it has, within a narrow field, produced some valuable experimental work—gives us a picture of man simplified beyond recognition, one that painstakingly leaves out nearly all that is distinctive of the human species and treats as non-existent precisely the things which every man knows to be the very stuff of his experience. Both tendencies are attempts to bring about the unification of science by leaving the fact of science itself—not to speak of certain other rather large facts—out of the reckoning. It seems, therefore, not useless to repeat that, while it is important for the philosopher to profit by what the scientific investigator has to tell of the objects that he studies, it is equally important to consider carefully what the investigator himself is doing, or supposing himself to be doing, when he studies them—what is implied in his assumptions that knowledge is possible and that it is serviceable to obtain it. When these implications are borne in mind, there appear, I think, certain fairly profound 'chasms' between man, the knower and planner—man looking before and after, and striving in some measure to shape his destiny thereby—and other, earlier-evolved members of the cosmos that this thought explores; so that most of all in himself and in his own achievements, feeble though they are, will he find reason for believing that nature has, in the course of her interminable travail, been able to acquire essentially new accomplishments and to enrich her store with genuine new creations.

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[28] *Issues and Tendencies in Contemporary Philosophy* (Univ. Calif. Publ. Philos., IV, 1924), pp. 24–48.